Profiling machine for shaping lengths of sheet metal

Patent number:	FR2766740
Publication date:	1999-02-05
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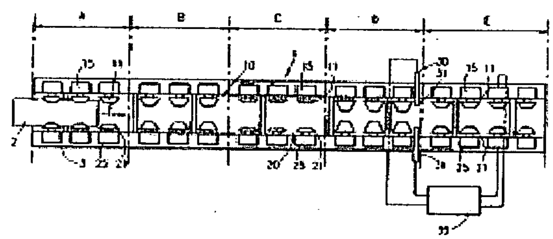
Classification:	
- international:	B21D5/12
- european:	B21D5/08
Application number:	FR19970009903 19970801
Priority number(s):	FR19970009903 19970801

Abstract of **FR2766740**

The shape produced is compared against a reference, and the rollers adjusted accordingly to achieve accurate profiling. The machine provides progressive profiling of sheet metal 2 in a profiling train 1. This consists of a series (10,20) of pairs of rollers between which the sheet metal passes. The profile is intended to be a U-shape with two parallel sections and a curved portion between. The shape of the curved profile is measured as it passes through the machine and compared with a reference value in order to determine the deviation from the required shape. The subsequent rollers of the machine are then controlled in order to correct the shape and bring it to match the required reference shape.



The subject of the present invention is a forming and installation process for a metal plate in a forming system.

In order to cold-form a profile using a flat metal sheet plate, use is known of a forming system consisting of multiple series of pairs of rollers which form successive stations between which the metal plate passes.

The interval between each pair of rollers traces the profile to be drawn in each station under consideration.

In this way, passing the metal plate between the complementary pairs of rollers allows the steel plate to be shaped so that the geometry of this plate progressively approaches the final geometry of the product to be obtained which comprises at least two folded longitudinal portions and connected by a curved coupling area.

In general, the last station of the forming system, called a thicknessing sander, gives the profile its final geometry, and the next-to-last station, called a surformer, which allows the elastic recoil of the edge or edges of the profile to be compensated for, by making a foldover angle or by decreasing the radius of the curved coupling areas.

But, the profile obtained often exhibits flaws in shape of which the primary ones are flaws called "diabolo" or "barrel" flaws.

Up to now, in order to reduce these flaws, the gap between at least one pair of rollers is adjusted manually and step by step by decreasing or increasing the play between these rollers as a function of the type of flaws noted.

However, it has been shown that this adjustment is completely random and that it may be shown to be correct for example for the beginning or end of the profiles and entirely inappropriate for the other parts of these profiles, or the inverse may be the case, and could even increase these flaws.

Thus, the formed profiles in the profiling installations comprises flaws which damage the

quality of the profiled products and which could impede certain applications, for example, the construction of metal frameworks for buildings.

The purpose of the invention is to avoid these drawbacks by proposing a profiling process and installation that will allow maximum reduction or elimination of the creation of diabolo or barrel flaws, whether these flaws are diabolo or barrel shaped.

The subject of the invention is therefore a progressive profiling process for a metal plate in a profiling system that consists of at least one series of pairs of rollers between which the metal sheet passes, in order to form a profile according to a predetermined shape and consisting of at least two longitudinal sections that are folded and connected to each other through a curved coupling area, distinguished by the fact that:

- a template is measured for at least one profile shaped in the profiling system according to the predetermined shape,
- this template is compared to a reference template and any differences between these two templates are determined; and that
- while the profiling is in progress, the pitch of at least one pair of rollers in the said series is adjusted so that it adapts to the curve radius of the curved coupling area and obtains a template profile that corresponds to the reference template.

According to other characteristics of the invention:

- the template of the said profile is measured as it is being formed in the profiling system,
- The template of the said profile is measured after it is formed in the profiling system.
- Measuring the profile's template consists of measuring the height of the said profile or of measuring the width of this profile or the folding angle between the said longitudinal areas of the profile.

Another subject of the invention is the progressive profiling installation of a metal plate in a profiling system consisting of at least one series of pairs of rollers, between which the metal plate passes in order to form a profile according to a predetermined shape and comprising at least two longitudinal sections, which are folded and connected together by a curved coupling area, distinguished by the fact that it comprises:

- a means for measuring the template of at least one shaped profile in the profiling system according to the predetermined shape.
- A means for recording a reference template and for comparing this reference template with the profile template.
- And a means for modifying the pitch of at least one pair of rollers in the series while profiling is taking place in order to adapt the curve radius of the curved coupling area and obtain a template profile that corresponds to the reference profile.

According to other characteristics of the invention:

- the means for measuring the profile template are made of photoelectric cells that are connected to the means of recording and comparison,
- the means for measuring the profile template consist of rollers in contact with the profile and connected to the means of recording and comparison,
- the means of modification of the pitch are formed by an endless screw that is driven in rotation by a control device and designed to shift a nut mounted on the said endless screw and integral with the axis of one of the rollers of the said pair of rollers.
- The means of modifying the pitch are formed by a cam which is driven in rotation by a driving gear and which fits into a connecting device that is integral with the axis of one of the rollers of the said pair of rollers.

The characteristics and advantages of the invention will become apparent with the description which follows, and which is given

solely as an example and which refers to the attached drawings, in which:

- Fig. 1 is a schematic view of the top of a profiling installation in compliance with the invention.
- Fig. 2 is a schematic elevation view of two pairs of rollers in the calibration station and which shows a primary manner of embodiment of the means of modifying the pitch of the said rollers.
- Fig. 3 is a schematic elevation view of two pairs of rollers in the calibration station and which shows a second manner of embodiment of the means of modification of the pitch of the said rollers.
- Figs. 4A to 4D are transverse section view showing the various stages of forming a profile.
- Fig. 5 is a transverse section view of one variation of a profile.

In figure 1, we have shown a progressive profiling installation of a metal plate 2 which comprises a profiling system that is designated in it entirety by reference 1.

In the following text, and for purposes of simplification, description shall be made of a profiling system that forms profiles in the shape of a U, where the installation in compliance with the invention applies to profiles of all shapes.

As shown in Fig. 4D, the U-shaped profile 4 comprises a central and longitudinal portion 5 and two lateral edges, respectively 5a and 5b, each of which are folded and connected to central portion 5 by curved coupling areas, respectively 6a and 6b.

The profiling system 1 can likewise form a profile using a continuous metal strip.

In the example of embodiment shown in Fig. 1, the profiling system 1 consists of a frame 3 that supports a series 10 of pairs of rollers located to the left relative to the direction F of passage of the metal plate 2 and

a series 20 of pairs of rollers located to the right relative to the said direction of passage F of the metal plate 2.

According to one variation, profiling system 1 can consist of a single series of pairs of rollers in order to produce for example profiles in the shape of a V.

Series 10 and 20 of rollers determine multiple successive stations and for example three successive fold-back stations A, B and C for edges 5a and 5b of profile 4 (Fig. 4B to 4D), with one station D called a surformer that allows compensation for the elastic recoil of edges 5a and 5b of profile 4 by making a fold-back angle or by decreasing the radius of the curved coupling areas 6a and 6b and a final station E called a calibrator which gives profile 4 its final geometry.

The number of station [sic] A, B and C of progressive folding back of edges 5a and 5b of profile 4 is a function of the complexity of the profile to be obtained.

As is shown in Figs. 2 and 3, series 10 and 20 each consist of complementary pairs of rollers.

For simplification purposes, the rollers in each pair shall be designated, respectively, the upper roller and lower roller in the following description.

Series 10 of rollers consists of pairs of upper rollers 11 and lower rollers 12 which are complementary.

Each upper roller 11 is driven in rotation by an axle 13 and each lower roller 12 is driven in rotation by an axle 14.

Axles 13 and 14 of each pair of rollers 11 and 12 are supported by a base 15 which rests on frame 3 and these axles 13 and 14 are driven in rotation by appropriate means, not shown.

Likewise, series 20 of rollers consists of upper pairs of rollers 21 and lower pairs of rollers 22 which are complementary.

Each upper roller 21 is driven in rotation by an axle 23 and each lower roller 22 is driven in rotation by an axle 24 and these axles 23 and 24 are supported by a base 25 which is supported on frame 3.

Axles 23 and 24 in series 20 of the rollers are driven in rotation by appropriate means, not shown.

According to one variation, the upper rollers 11 and 21 corresponding pairs of rollers in series 10 and 20 may be mounted on a common axle and the lower rollers 12 and 22 may likewise be mounted on a common axle.

Moreover, the pitch between the upper and lower rollers may be different depending on the placement of the pair of rollers in the profiling system and depending on the profile to be obtained.

Depending on the position of the pairs of upper rollers 11 and 21 and lower rollers 21 [sic] and 22 in the profiling system 1, the rollers have specific shapes which are adapted to the operation to be carried out and the interval between upper rollers 11 and 21 and lower rollers 12 and 22 traces the profile to be carried out in the operation under consideration.

Metal plate 2 is introduced into the profiling system 1 and successively passes between upper rollers 11 and 21 and lower rollers 12 and 22 of forming stations A, B and C in order to progressively fold back the lateral edges 5a and 5b as shown in Figs. 4B and 4C in order to obtain a profile 4 for example in the shape of a U.

Subsequently, profile 4 passes between the rollers in the surforming station D which allows elastic recoil of edges 5a and 5b of profile 4 to be compensated for by making a fold-back angle or by decreasing the radius of the curved coupling areas 6a and 6b and profile 4 passes between the rollers of calibration 2 [sic] station E in order to give this profile 4 its final geometry.

However, the profile 4 obtained often presents flaws in shape which are primarily “diabolo” or “barrel” flaws.

In order to reduce to a minimum or to eliminate the creation of this type of flaw in profile 4, the profiling installation includes:

- a means 30 of measuring the template of at least one profile formed in the profiling system 1 according to the predetermined shape,
- a means 35 of recording a reference template and of comparing this reference template with the profile template 4,
- and a means 40 of modification during profiling of the pitch of at least one pair of upper rollers 11 and 21 and lower rollers 12 and 22 in order to adapt the curve radius of the curved coupling areas 6a and 6b and obtain a profile 4 of the template corresponding to the reference template.

In the example of embodiment shown in Fig. 1, the means 30 for measuring the profiles template are arranged between the surforming station D and calibrating station E in order to measure the profile template as it is being formed.

These means of measurement 30 can be arranged at another place in the profiling system 1 or at the outlet of this profiling system in order to measure the profile template after it has been formed.

The means 30 of measuring the profiled template 4 consists for example of photoelectric cells 31 which are connected to the recording and comparison means 35 or by rollers or any other device in contact with profile 4 and connected to means of recording and comparison 35.

Depending on the shape of profile 4, the means 30 that measure either the height h of this profile 4 (Fig. 4d), or the width 1 of the said profile 4 (Fig. 5), for example in the case where this latter consists of lateral edges 7a and 7b or is

the folding angle between the longitudinal sections of the profile.

As shown in Fig. 1, the means 35 of recording the reference template and of comparing this reference template with the profile template 4 are connected to the means 40 of modifying the pitch of at least one pair of upper rollers 11 and 21 and lower rollers 12 and 22 for example of calibrating station E.

To do this, and as shown in Figs. 2 and 3, axles 14 and 24 of lower rollers 12 and 22 of at least one pair of rollers in calibrating station E are mounted so that they can be moved vertically on the bases, respectively 15 and 25.

In this case, axles 13 and 23 of upper rollers 11 and 21 of the corresponding pair of rollers are affixed in translation on bases 15 and 25.

According to one variation, axles 13 and 23 of upper rollers 11 and 21 can be mounted so that they can be moved vertically on bases 15 and 25 and in this case axles 14 and 24 of lower rollers 12 and 22 of the corresponding pair are affixed in translation on bases 15 and 25.

According to a primary manner of embodiment shown in Fig. 2, the means 40 of modification of the pitch between the upper rollers 11 and 21 and the lower rollers 12 and 22 are formed for, [sic] each lower roller 12 and 22, by a motor 41 which drives an inlet pinion 42 in rotation which meshes with an intermediate pinion 43 which itself meshes with an outlet pinion 44.

The outlet pinion 44 drives an endless screw 45 in rotation, which displaces a nut 46 which is integral with axle 14 of lower roller 12.

An identical device is provided to vertically displace axle 24 and lower roller 22.

In this way, the vertical displacement of the lower rollers 12 and 22 using motors 41, pinions 42, 43 and 44, endless screw 45 and nuts 46 allows adjustment

of the pitch between the upper rollers 11 and 21 and lower rollers 12 and 22.

First of all, a reference template profile is measured and the data obtained are introduced into the recording device 35.

As the profile 4 passes in front of measuring device 30, the template of this profile 4, i.e. its height or width or the folding angle between the longitudinal areas, is measured and the data obtained are introduced into recording devices 35.

These devices 35 compare the reference template with the profile template 4 formed in the profiling system 1 according to the predetermined shape and control motors 41 so that they modify the pitch between the upper rollers 11 and 21 and lower rollers 12 and 22 of at least one pair of rollers, for example of the calibrating station E in order to adapt the curve radius of the curved coupling areas 6a and 6b in order to obtain a profile 4 of the template that corresponds to the reference template.

If the measured height of profile 4 is greater than the height of the reference profile, the curve radius of curved portions 6a and 6b is reduced by the coupling of lower rollers 12 and 22 with upper rollers 11 and 21 and if the measured height of profile 4 is lower than the height of the reference profile, the radius of curvature of curved areas 6a and 6b is increased by the increase in the pitch between the lower rollers 12 and 22 and upper rollers 11 and 21.

This is also the case where the width of profile 4 or the fold angle was measured.

According to one variation, the means 30 of measuring the profile template 4 can be located at the output of profiling system 1 and, in this case, the lower rollers 12 and 22 of at least one pair of rollers, for example of calibrating station E are pre-positioned relative to the upper rollers 11 and 21 of the said pair of rollers as a

function of the results obtained so as to obtain template profiles that correspond to the reference template.

According to another manner of embodiment shown in Fig. 3, the means 40 of modifying the pitch between the upper rollers 11 and 21 and lower rollers 12 and 22 of at least one pair of rollers in calibration station E are formed, for each lower roller 12 and 22, by a cam 47 which is driven in rotation by a driving gear 48 which is itself driven in rotation by a motor, which is not shown.

Cam 47 meshes with a connecting device 49 which is integral with axle 14 of lower roller 12.

A similar device is provided for lower roller 22.

In this way, the vertical displacement of lower rollers 12 and 22 under the action of cams 47, driving gears 48 and connecting devices 49 allow us to modify the pitch between the upper rollers 11 and 21 and lower rollers 12 and 22.

This manner of embodiment can be applied more specifically in the case where the shape of the flaw in profile 4 is known and is reproduced for an entire series of identical profiles.

Each turn of cam 47 corresponds to one length of the profile and one cam 47 is provided for each product line.

The measuring device 30 as well as the recording means 35 and the means 40 for modifying the pitch of at least one pair of rollers can be mounted on existing profiling systems and they offer the advantage of being able to correct all types of flaws.

The suppression of "diabolo" or "barrel" flaws allows us to obtain profiled products of consistent quality.

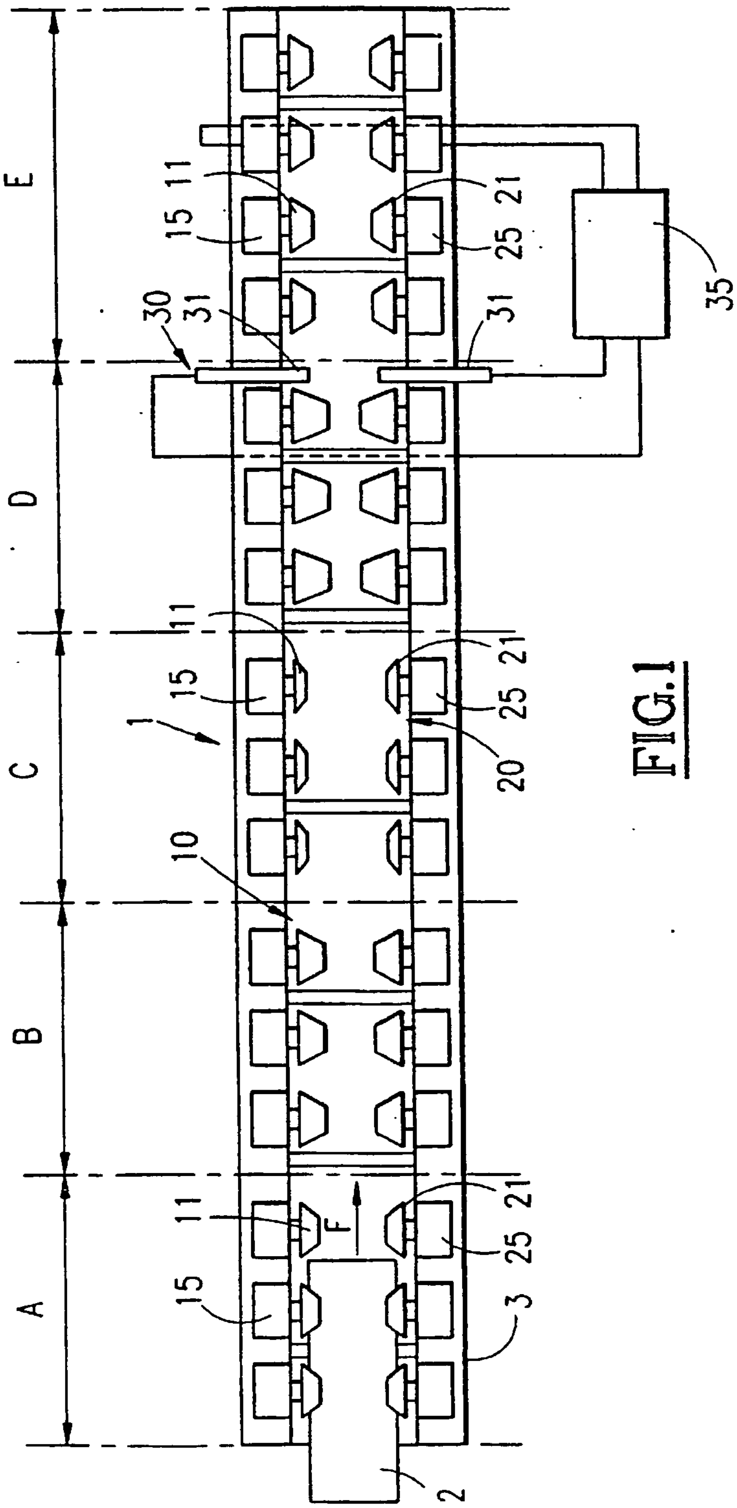


FIG.1

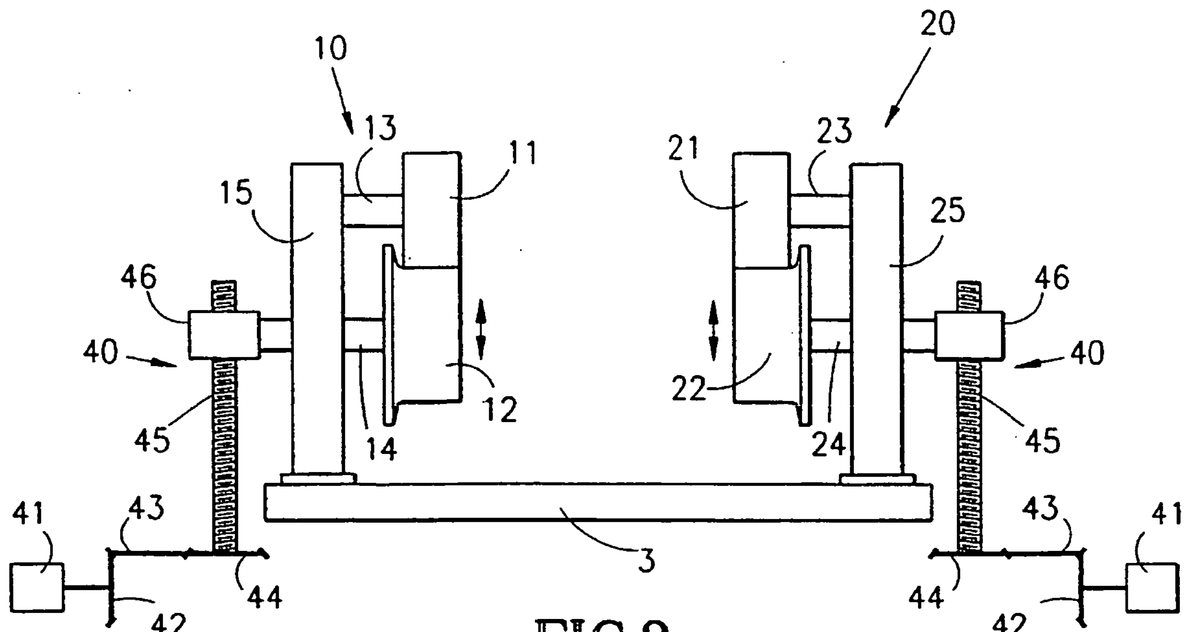

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FIG.2

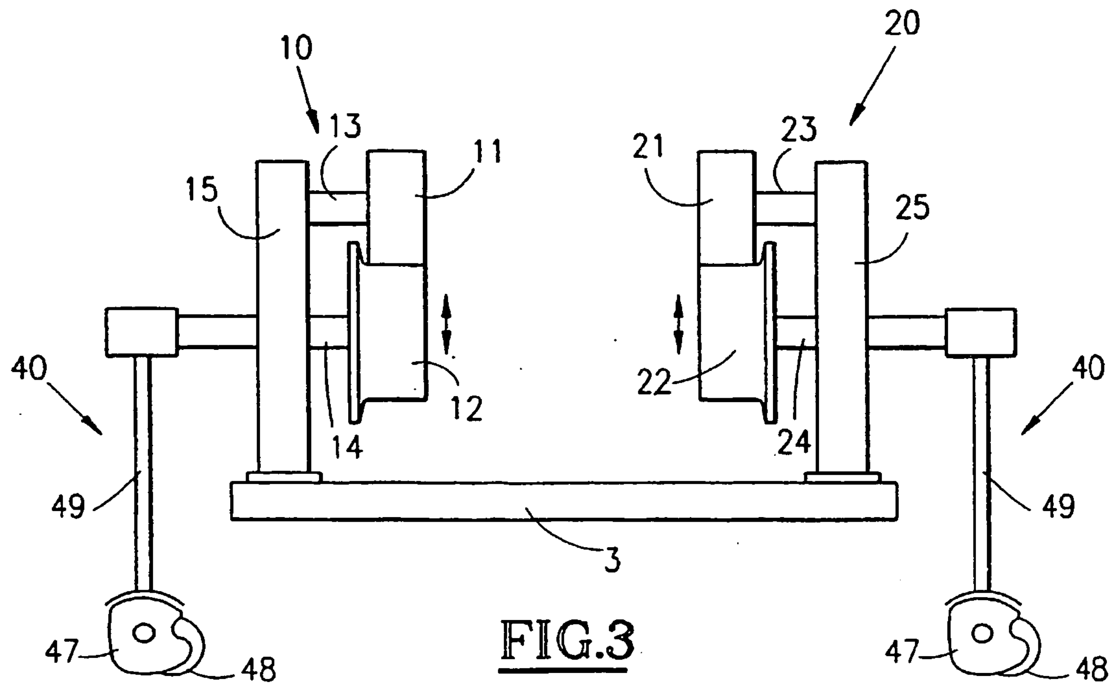
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FIG.3

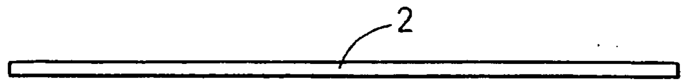

FIG.4A

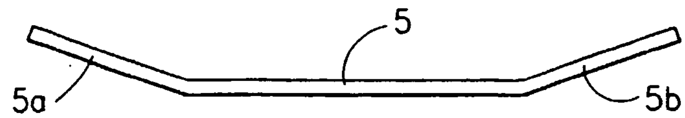

FIG.4B

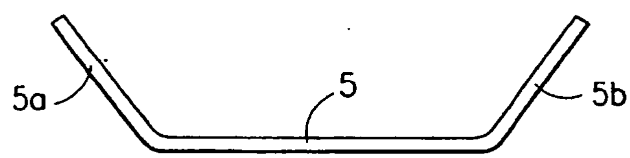

FIG.4C

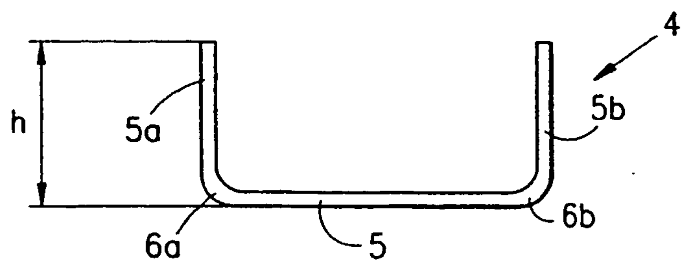

FIG.4D

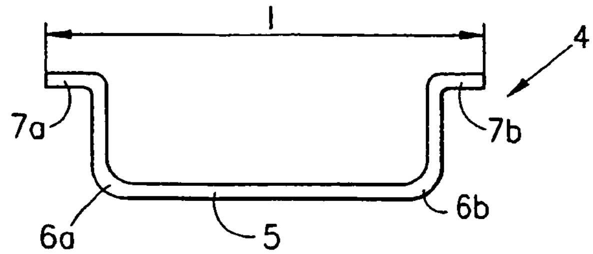

FIG.5